Instruction Handbook for....

AIL Type 132

PRECISION TEST RECEIVER

February 1963

CUTLER-HAMMER

AIRBORNE INSTRUMENTS LABORATORY
DEER PARK, LONG ISLAND, NEW YORK

CONTROL AIL DIVISION

Instruction Handbook for . . . .

AIL Type 132

PRECISION TEST RECEIVER

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TABLE OF CONTENTS

		Page
I.	Introduction	1
II.	Specifications	2
III.	Operating Controls and Indicators	5
IV.	Operating Instructions	6
	A. Preparation for Use	6
	B. Operation	6
	C. Setup Procedure	6
	D. IF Gain Measurement	6
	E. IF Loss Measurement	7
	F. RF Gain Less Than 40 db	8
	G. RF Loss Less Than 40 db	9
	H. RF Gain or Loss Greater Than 40 db	9
	I. Noise-Figure Measurement	10
V.	Theory of Operation	12
	A. Basic Equipment	12
	B. Gain Measurement	12
	C. Noise-Figure Measurement	13
	D. Functional Description of Units	14
VI.	Maintenance Instructions	16
	A. Piston Attenuator	16
	B. Power Supply	16
	C. Post Amplifier	17
	D. Receiver	20
	E. Factory Repair	20
VII.	Replaceable Parts List--Type 132 Receiver	23
Appendix--Preamplifiers		

LIST OF ILLUSTRATIONS

Figure		Page
1	Type 132 Precision Test Receiver	Frontispiece
2	Type 132 Precision Test Receiver--Front Panel Controls, Indicators, and Connectors	4
3	Setup for Measurement of IF Gain or Loss	7
4	Setup for Measurement of RF Gain or Loss	9
5	Setup for Noise Figure Measurement	10
6	Noise Figure vs Y-Factor for Various Discharge Generators	11
7	Type 132 Precision Test Receiver, Block Diagram	12
8	Power Supply, Schematic Diagram	16
9	30-Mc Post Amplifier, Schematic Diagram	18
10	60-Mc Post Amplifier, Schematic Diagram	19
11	Type 132 Precision Test Receiver, Schematic Diagram	21
12	Component Identification	22

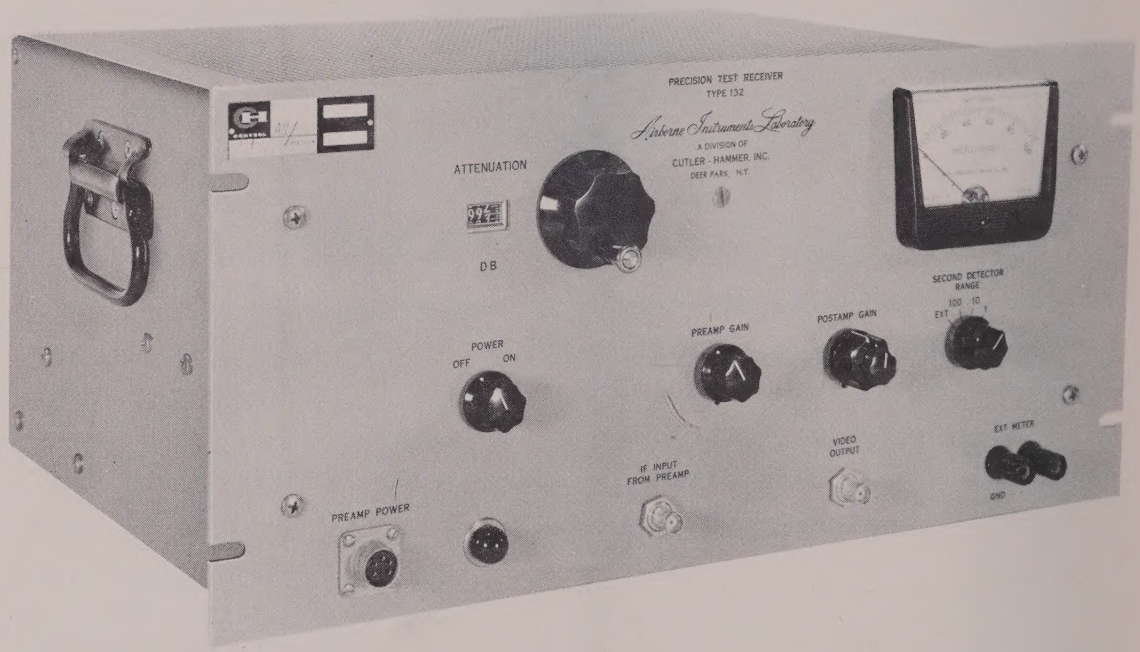


FIGURE 1. TYPE 132 PRECISION TEST RECEIVER

I. INTRODUCTION

The AIL Type 132 Precision Test Receiver, Figure 1, is a laboratory test instrument that consists of an IF Post Amplifier, a Power Supply, and a Precision Attenuator. Among the many available applications for the Receiver are the highly accurate measurement of:

1. Noise figure, using the IF attenuation (Y-factor) method,
2. Gain and linearity of IF and RF amplifiers,
3. Characteristics of directional couplers,
4. Calibration of RF attenuators,
5. Selectivity characteristics of RF devices.

The Receiver is available in two standard models: Part Number 13210 for use at 30 Mc, and Part Number 13211 for use at 60 Mc.

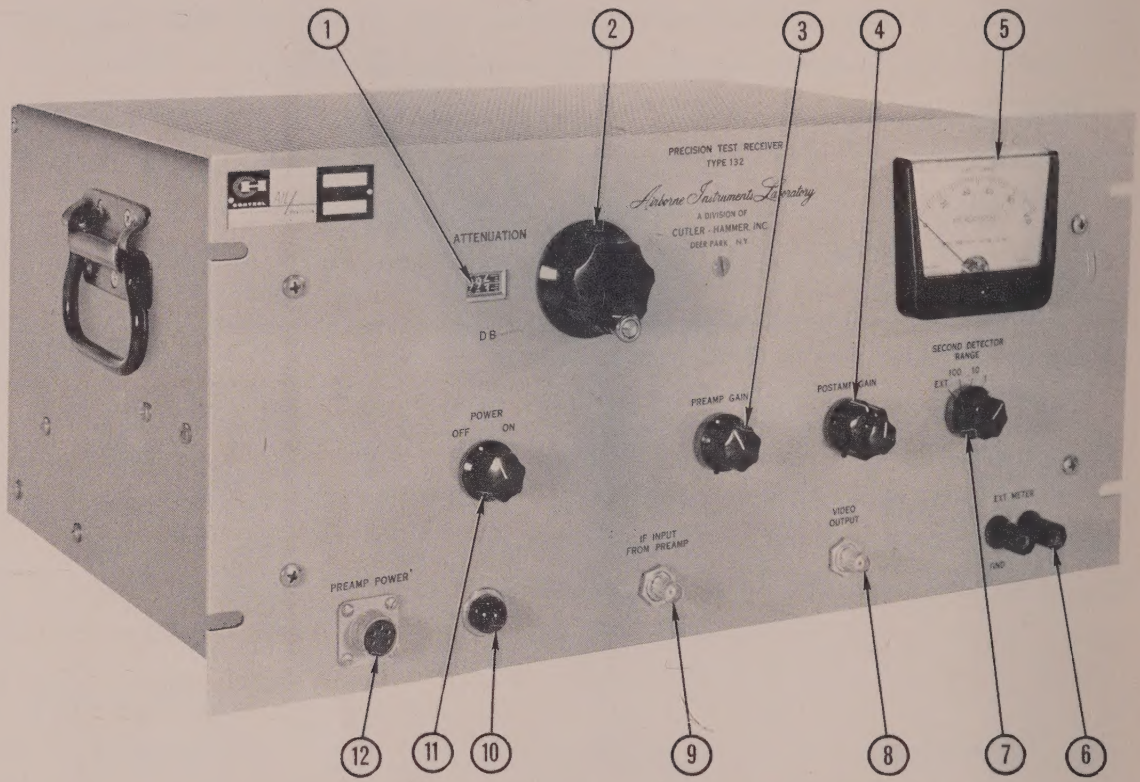
Unless otherwise noted, all data in the following sections applies to both of the standard models.

II. SPECIFICATIONS

For convenience of comparison, the specifications for the Type 132 Precision Test Receiver are presented in two separate columns, one for each standard model.

	Part Number 13210	Part Number 13211
Center Frequency	30 Mc	60 Mc
Attenuator		
Range	80 db	80 db
Accuracy	±0.05 db per 10 db	±0.05 db per 10 db
Insertion Loss	Approximately 25 db	Approximately 25 db
Input Impedance	50 ohms (nominal)	50 ohms (nominal)
Output Impedance	50 ohms (nominal)	50 ohms (nominal)
Precision	Smallest dial division is 0.02 db	
Post Amplifier		
Bandwidth	Greater than 2 Mc	Greater than 2 Mc
Voltage Gain (IF)	Greater than 10,000	Greater than 5,000
Gain Control Range (minimum)	40 db	40 db
Input Impedance:	50 ohms	50 ohms
Second Detector Output	0 to 500 μamp into a 1000-ohm load	
Video Amplifier Voltage Gain	Greater than 10	Greater than 10
Video Amplifier Linearity	Tilt less than 10 percent for a pulse width of 1 to 100 μsec into a 1000-ohm load; voltage output at least 10 volts before limiting	
Video Amplifier Output Impedance	Less than 250 ohms	Less than 250 ohms

	Part Number 13210	Part Number 13211
Receiver		
Size	8-3/4 in. high x 19 in. wide x 14 in. deep	
Weight	60 pounds net, 75 pounds shipping	
Primary Power	115 volts, single phase, 60 cps, 50 watts	



1. ATTENUATION DB Indicator
2. Attenuator Knob
3. PREAMP GAIN Control
4. POSTAMP GAIN Control
5. SECOND DETECTOR Output Meter
6. EXT METER Jacks
7. RANGE Control
8. VIDEO OUTPUT Connector
9. IF INPUT FROM PREAMP Connector
10. Pilot Light
11. POWER ON-OFF Switch
12. PREAMP POWER Connector

FIGURE 2. TYPE 132 PRECISION TEST RECEIVER--FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

III. OPERATING CONTROLS AND INDICATORS

Figure 2 shows the Receiver front panel controls and indicators.

Reference No.	Nomenclature	Function
1	ATTENUATION DB Indicator	Indicates attenuation setting
2	Attenuator Knob	Controls attenuation settings continuously from 0 to 80 db
3	PREAMP GAIN Control	Adjusts cathode bias resistance of last two stages of preamplifier
4	POSTAMP GAIN Control	Adjusts cathode bias resistance of first two stages of post amplifier
5	SECOND DETECTOR Output Meter	Indicates second detector current
6	EXT METER Jacks	Provides means of connecting detector to external meter
7	RANGE Control	Selects X1, X10, or X100 range on 100 μamp second detector microammeter In EXT setting it switches second detector current output to external meter jacks
8	VIDEO OUTPUT Connector	Provides external output of video amplifier
9	IF INPUT FROM PREAMP Connector	Provides input to attenuator
10	Pilot light	Indicates when POWER ON-OFF switch is set to ON
11	POWER ON-OFF Switch	Controls primary power to power supply
12	PREAMP POWER Connector	Provides power for external preamplifier

IV. OPERATING INSTRUCTIONS

A. PREPARATION FOR USE

Although the Receiver is shipped ready for use, it should be carefully inspected for any evidence of damage that might have occurred in shipment. Check for loose tubes, and for loose wires or connections.

B. OPERATION

The following paragraphs describe Receiver operation for several types of measurements, which were selected to demonstrate the versatility of the Receiver. However, the Receiver is obviously not so restricted and has many other possible applications, such as SWR measurements, and the measurement of coupler characteristics and selectivity characteristics.

C. SETUP PROCEDURE

Set up the Receiver as follows:

1. Rotate the POSTAMP GAIN (fine and coarse) control fully counterclockwise.
2. Turn the Attenuator knob to obtain a 0.00 db reading on the ATTENUATION DB indicator.
3. Set the RANGE control to 100.
4. Connect the AC line cord on the Receiver to a source of 115-volt, 60-cps, AC power.
5. Set the POWER ON-OFF switch to ON and allow the equipment to warm up for 5 minutes.

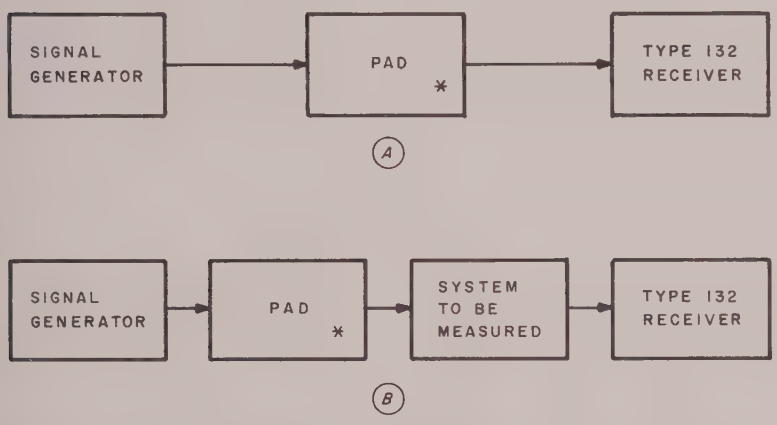
D. IF GAIN MEASUREMENT

1. Set up the equipment as shown in Figure 3A.
2. Set the signal generator output to zero and the RANGE control to 1. Adjust the POSTAMP GAIN control until noise level reading on the SECOND DETECTOR output meter is about 10.

3. Increase the signal generator output until the reading on the SECOND DETECTOR output meter is at some precise level near the top of the scale, such as 80. Note this reading.

4. Set the RANGE control to 100 and connect the system to be measured (Figure 3B) to the Receiver.

5. Turn the Attenuator knob, thereby increasing the attenuation enough to permit current readings with the RANGE control at 1. Then adjust the Attenuator knob until the meter indicates the exact reading noted in step 2. The ATTENUATION DB indicator will then indicate the IF gain of the system.



* IF THE SOURCE IMPEDANCE OF THE SYSTEM TO BE MEASURED IS CRITICAL, IT IS DESIRABLE TO PAD THE OUTPUT OF THE SIGNAL GENERATOR WITH A 6-DB OR 10-DB MATCHED PAD.

FIGURE 3. SETUP FOR MEASUREMENT OF IF GAIN OR LOSS

E. IF LOSS MEASUREMENT

1. Set up the equipment as shown in Figure 3B.

2. Set the signal generator output to zero and the RANGE control to 1. Adjust the POSTAMP GAIN control until noise level reading on the SECOND DETECTOR output meter is about 10.

3. Increase the signal generator output until the reading on the SECOND DETECTOR output meter is at some precise level near the top of the scale, such as 80. Note this reading.

4. Set the RANGE control to 100 and disconnect the system being measured (Figure 3A) from the Receiver.

5. Turn the Attenuator knob, thereby increasing the attenuation enough to permit current readings with the RANGE control at 1. Then adjust the Attenuator knob until the meter indicates the exact reading noted in Step 3. The ATTENUATION DB indicator will then indicate the IF loss of the system.

F. RF GAIN LESS THAN 40 DB

1. Set up the equipment as shown in Figure 4A.
2. Set the signal generator output to zero and the RANGE control to 1. Adjust the POSTAMP GAIN control and the PREAMP GAIN control until the noise level reading on the SECOND DETECTOR output meter is about 40.
3. Increase the signal generator output until the reading on the SECOND DETECTOR output meter is about 80. Note the exact reading.

CAUTION

In this arrangement of the test equipment the accuracy of measurement is affected by the linearity of the mixer and preamplifier that are located between the precision attenuator and the system under test.

It is essential to operate the mixer and preamplifier within their linear ranges to obtain the full accuracy of the attenuator in the Receiver (see Appendix). The signal level into the mixer must not exceed 10 percent of the local oscillator power and the preamplifier must be operated within its linear range (refer to the instruction material supplied with the preamplifier).

4. Set the RANGE control to 100 and connect the system to be tested to the test setup as shown in Figure 4B.
5. Turn the Attenuator knob, thereby increasing the attenuation enough to permit current readings with the RANGE control at 1. Then adjust the Attenuator knob until the meter indicates the exact reading noted in Step 3. The ATTENUATION DB indicator will then indicate the RF gain of the system.

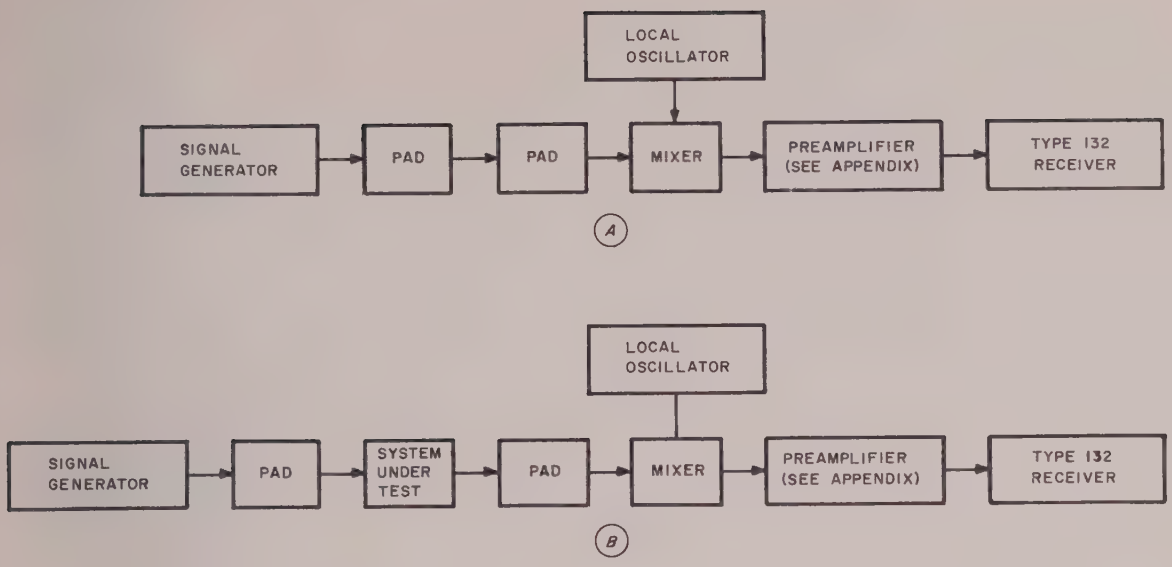


FIGURE 4. SETUP FOR MEASUREMENT OF RF GAIN OR LOSS

G. RF LOSS LESS THAN 40 DB

This measurement is accomplished by reversing the procedure discussed in Paragraph F.

H. RF GAIN OR LOSS GREATER THAN 40 DB

To measure RF gain or loss greater than 40 db, well-matched, calibrated RF pads of less than 40 db must be used. These pads can be calibrated with the Receiver by reversing the procedure described in Paragraph F.

To measure a system that has a loss of about 65 db, proceed as follows:

1. Set up the equipment as shown in Figure 4B.
2. Set the signal generator output to zero and the RANGE control to 1. Adjust the POSTAMP GAIN and the PREAMP GAIN controls until the noise level reading on the SECOND DETECTOR output meter is about 40.

3. Increase the signal generator output until the reading on the SECOND DETECTOR output meter is at some precise level near the top of the scale, such as 80. Note this reading.

4. Set the RANGE control to 100 and disconnect the system under test from the test setup (Figure 4A).

5. Insert at least 20 db of calibrated attenuation in place of the disconnected system.

6. Turn the Attenuator knob, thereby increasing the attenuation enough to permit current readings with the RANGE control at 1. Then adjust the Attenuator knob until the meter indicates the exact reading noted in Step 3. The reading on the ATTENUATION DB indicator plus the value of the fixed attenuators used is the RF loss of the system.

I. NOISE-FIGURE MEASUREMENT

Noise figure is best measured by the "Y" factor method, and is accomplished as follows:

1. Set up the equipment as shown in Figure 5.

2. Set the ATTENUATION DB indicator to zero and the RANGE control to 1.

3. With the noise generator turned off, set the PREAMP GAIN control to maximum and the POSTAMP GAIN control to produce a reading near full scale on the SECOND DETECTOR output meter. Note the exact reading.

4. Turn the noise generator on and adjust the Attenuator knob to obtain the same reading on the SECOND DETECTOR output meter as noted in Step 3. The "Y" factor is the reading on the ATTENUATION DB indicator. The noise figure can be determined from Figure 6 for the particular noise generator used.

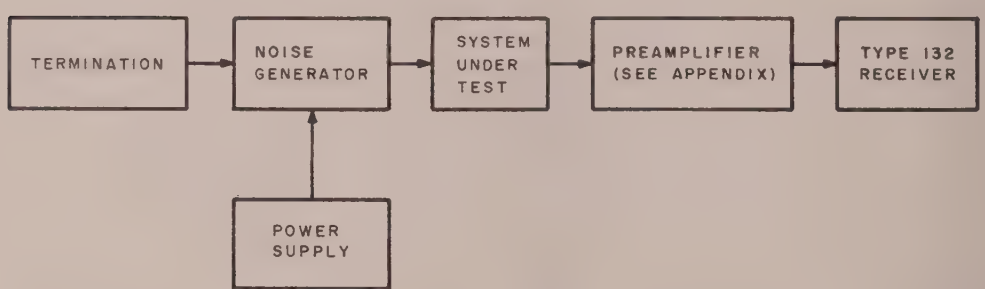


FIGURE 5. SETUP FOR NOISE FIGURE MEASUREMENT

NOTE

If a variable-output-power noise generator is used (such as a noise diode) it is convenient to use a "Y" factor of 2:1 (3 db). In this case, proceed as described in Steps 1, 2, and 3. In Step 4, set the attenuator to 3 db and adjust the noise generator output to produce the same reading on the SECOND DETECTOR output meter. Record the noise generator current. The noise figure (F) is then given by the following expression:

$$F_{(db)} = 10 \log 20IR$$

where

R = noise generator impedance (ohms)

I = noise generator current for Y = 2 (amperes)

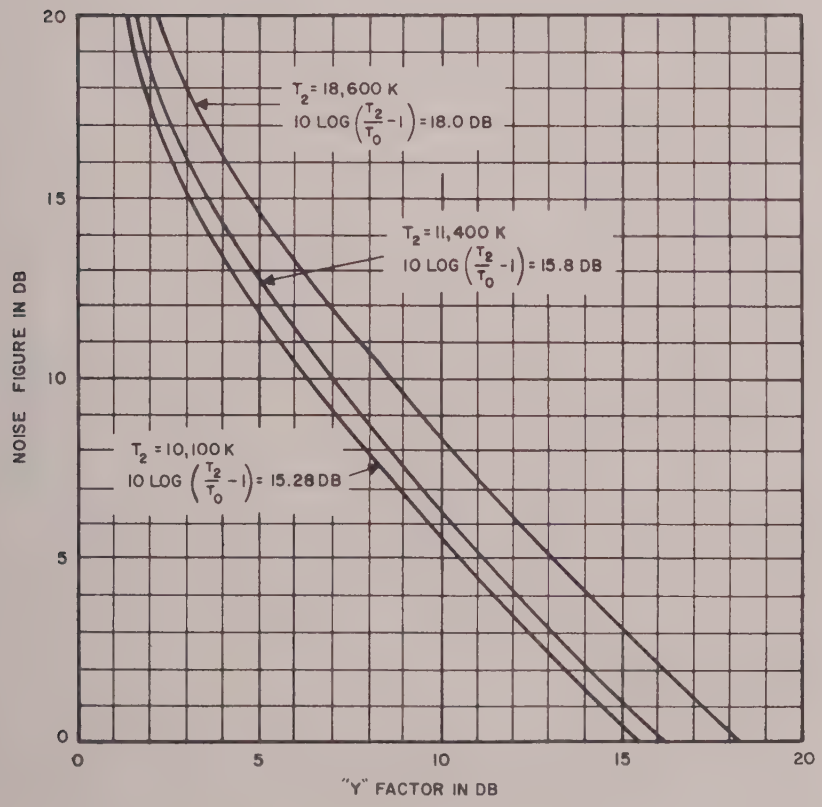


FIGURE 6. NOISE FIGURE VS "Y" FACTOR FOR VARIOUS DISCHARGE GENERATORS

V. THEORY OF OPERATION

A. BASIC EQUIPMENT

The Receiver is basically an IF amplifier having the means for precision insertion of finely controlled amounts of attenuation (see Figure 7). When a proper preamplifier is used, the Receiver can operate with a wide variety of standard microwave mixers. The precision-attenuation characteristics can, therefore, be transferred to microwave frequencies. Because of its adaptability and accuracy, the equipment has many laboratory applications, such as measurement of IF gain and loss, RF gain and loss, and microwave receiver noise figure. Examples of frequent Receiver applications for measuring gain and noise figure are discussed in the following paragraphs.

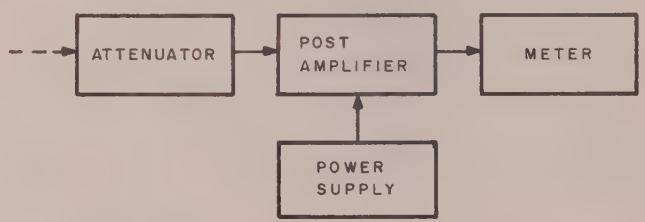


FIGURE 7. TYPE 132 PRECISION TEST RECEIVER, BLOCK DIAGRAM

B. GAIN MEASUREMENT

One of the most satisfactory means of making gain (or loss) measurements is by the substitution method, whereby the device under test is connected to the testing instrument, and the instrument output indication for a given input signal is noted. The device is then disconnected from the instrument, and the original output level is re-established by either of two means: increasing the signal-generator output, or decreasing the attenuation in the test instrument. With the Receiver, the use of the attenuation technique is considered preferable for the following reasons:

1. If the device under test is connected directly in series with the attenuator, the entire system is operating at the same signal levels under both conditions of measurement. This eliminates problems caused by nonlinearities in any of the amplifiers associated with the measurement.

2. The attenuators associated with signal generators are not sufficiently precise for many measurements. Errors are caused in these attenuators by objectionable amounts of backlash in their drive systems when the attenuators must operate over the frequency range of the particular signal generator. The use of a secondary standard of attenuation at a fixed intermediate frequency eliminates these shortcomings.

C. NOISE-FIGURE MEASUREMENT

The gas-discharge type of noise generator is most often used to measure the noise figures of microwave receivers. Because the output power of such generators is not variable, the ratio of output powers under generator-on and generator-off conditions will vary with the noise figure of the receiver under test. This ratio, termed the "Y" factor, is rapidly and accurately determined with the precision attenuator in the Receiver.

The general formula for deriving the noise figure (F) of a microwave receiver (using a gas-discharge type noise source) is as follows:

$$F = \frac{\left(\frac{T_2}{T_o} - 1\right) - Y\left(\frac{T_1}{T_o} - 1\right)}{Y - 1}$$

where

T_2 = effective temperature of the discharge generator in the "on" condition (degrees Kelvin)

T_1 = effective temperature of the discharge generator in the "off" condition (degrees Kelvin)

T_o = 290 degrees Kelvin

Y = ratio of the noise output power of the receiver, with the noise generator on to that with the noise generator off

In most practical cases, $T_1/T_o \approx 1$, so that the above formula reduces to:

$$F = \frac{\left(\frac{T_2}{T_o} - 1\right)}{Y - 1}$$

$$F_{db} = 10 \log\left(\frac{T_2}{T_o} - 1\right) - 10 \log (y - 1)$$

Precise measurements of Y are obtained by means of the precision attenuator in the Receiver.

D. FUNCTIONAL DESCRIPTION OF UNITS

1. IF ATTENUATOR

The IF attenuator is of the waveguide-beyond-cutoff type. The amount of attenuation is determined by the spacing between the input and output loops and by the diameter of the circular waveguide in which the loops are mounted. The waveguide is manufactured to very close tolerances, as is the mechanical drive system controlling the loop spacing. Minimum spacing between the loops is adjusted so that the coupling is achieved solely by means of the TE_{11} mode of propagation; and the linearity of the attenuator, as a function of the loop spacing, is ensured.

The law of the attenuator (attenuation vs loop spacing) is practically independent of frequency since the waveguide is well below cutoff. The insertion loss of the attenuator, however, varies with frequency, and care must be taken in making gain measurements as a function of intermediate frequency. The indicator reading of the attenuator setting is not to be taken as a measure of the total insertion loss. The difference between two readings at any frequency in the specified band ($\pm$16 percent of the design center frequency) is, however, a direct measure of the change in gain or loss to an accuracy of $\pm$0.05 db for each 10 db.

The input and output coils of the attenuator are each in series with a capacitor and resistor. The series R-L-C circuit is resonated at 30 Mc or 60 Mc, and the Q of the circuit is sufficiently low to restrict the input SWR, within the $\pm$16 percent bandwidth, to less than 1.5.

2. POST AMPLIFIER

The post amplifier consists of five stages of stagger-tuned amplification followed by a crystal detector and a video amplifier with a cathode-follower output.

The input circuit presents an effective 50-ohm impedance at all input frequencies in the amplifier pass band. The amplifier circuit is conventional. CR1, the crystal detector, detects the IF signal. The second-detector current is brought to a meter circuit on the front panel of the Receiver. The input-to-output characteristic of the Receiver is practically linear. A single stage of video amplification with a cathode-follower output delivers video signals to the VIDEO OUTPUT jack. Gain control is achieved by adding resistance in series with the cathode resistors of the first two stages.

3. POWER SUPPLY

The power supply, which provides operating voltages for all the units in the Receiver, is a standard constant-voltage transformer unit.

A thermal relay is provided to allow a minimum of 30 seconds between the time the power switch is turned on and the time the 150 v DC is applied to the tube plates.

VI. MAINTENANCE INSTRUCTIONS

A. PISTON ATTENUATOR

Maintenance of the piston attenuator is limited to oiling of the piston semiannually. Crank the piston about 1/2 inch out from the fully seated position and apply one drop of light instrument oil to the piston near the bearing. Crank the piston in and out to distribute the oil.

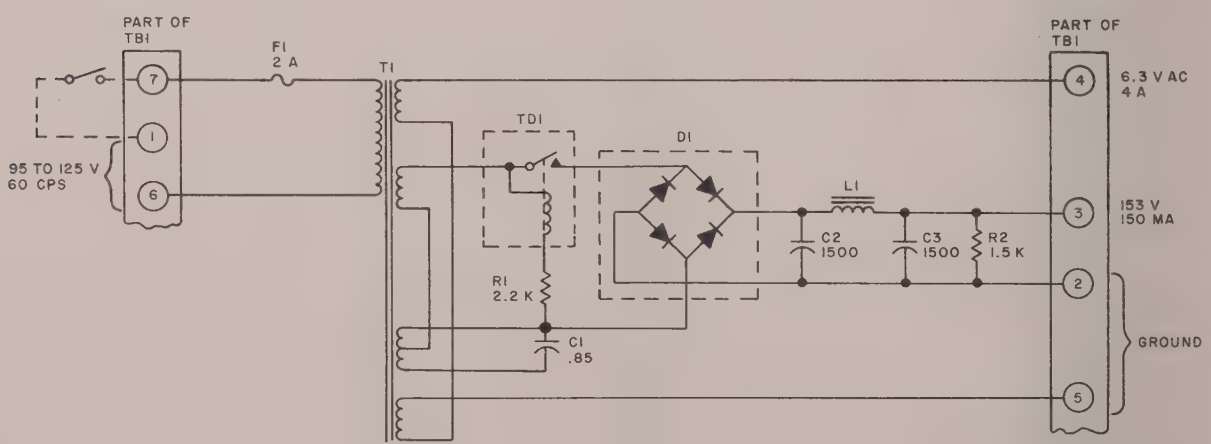
CAUTION

Do not over oil, because oil inside the piston sleeve will cause electrical malfunction. Do not attempt to disassemble the unit or make gear train adjustments. Return the unit to the factory for any repairs.

B. POWER SUPPLY

The power supply used in the Receiver provides regulated filament and DC power. A thermal relay allows a minimum of 30 seconds between the time filament power is turned on and the DC is applied to the tube plates.

A schematic diagram of the power supply (Figure 8) is provided to assist in routine troubleshooting.



UNLESS OTHERWISE NOTED:
RESISTANCE VALUES IN OHMS
CAPACITANCE VALUES IN UF

FIGURE 8. POWER SUPPLY, SCHEMATIC DIAGRAM

C. POST AMPLIFIER

The following procedure describes alignment of the post amplifier.

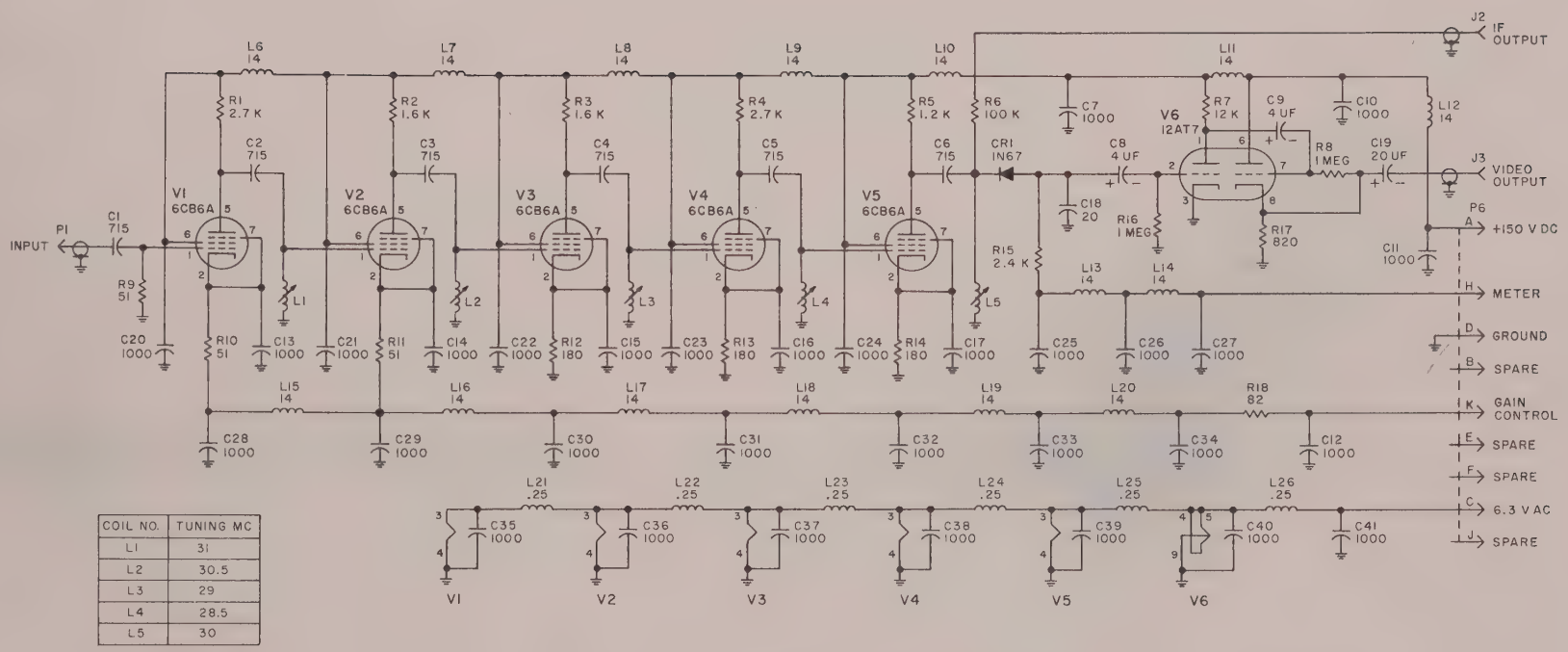
1. Set up the equipment as shown below.

2. Set the POSTAMP GAIN control to its full clockwise position.
3. Set Second Detector RANGE control to 1.
4. Set signal generator to proper frequency, 30 Mc for part no. 13240 or 60 Mc for part no. 13241.
5. Set signal generator output to produce a reading of between 60 and 100 μamp on the SECOND DETECTOR OUTPUT meter.
6. Align the post amplifier for maximum output, as indicated on the SECOND DETECTOR OUTPUT meter, by tuning the coils to the frequencies listed below.

	Part No. 13240	Part No. 13241
L1	31.0 Mc	61.0 Mc
L2	30.5 Mc	60.5 Mc
L3	29.0 Mc	59.0 Mc
L4	28.5 Mc	58.0 Mc
L5	30.0 Mc	60.0 Mc

7. Set the signal generator frequency to the frequency that produces the maximum output.
8. Set signal generator output to produce a reading of 100 μamp on the SECOND DETECTOR OUTPUT meter.
9. Increase the signal generator frequency until the SECOND DETECTOR OUTPUT meter reads 70 μamp. This frequency should be 31 Mc (61 Mc) or higher.
10. Decrease the signal generator frequency until the SECOND DETECTOR OUTPUT meter reads 70 μamp. This frequency should be 29 Mc (59 Mc) or lower.
11. Adjust L5, if necessary, to obtain the proper bandpass requirements.

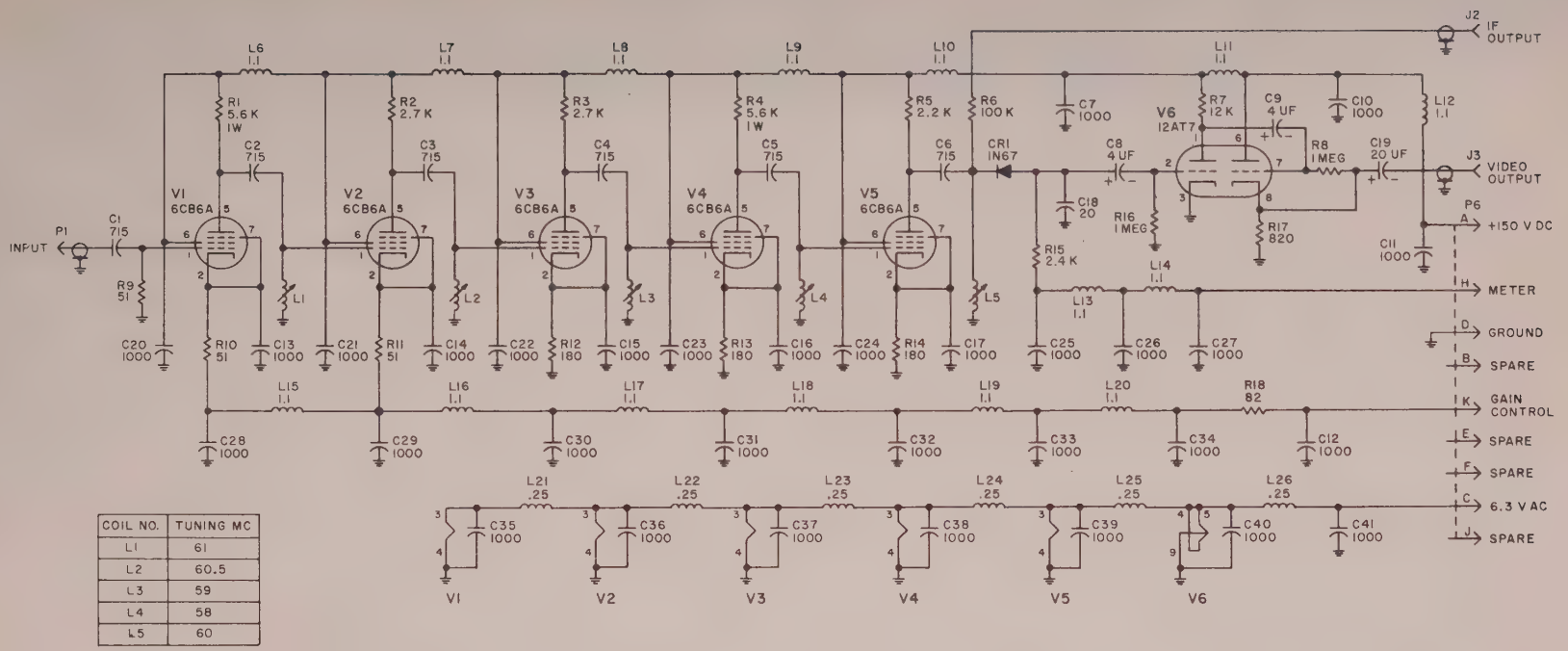
Schematic diagrams (Figures 9 and 10) are provided to assist in troubleshooting the post amplifier.



COIL NO.	TUNING MC
L1	31
L2	30.5
L3	29
L4	28.5
L5	30

UNLESS OTHERWISE NOTED:
RESISTANCE VALUES IN OHMS
CAPACITANCE VALUES IN UUF
INDUCTANCE VALUES IN UH

FIGURE 9. 30-MC POST AMPLIFIER, SCHEMATIC DIAGRAM



COIL NO.	TUNING MC
L1	61
L2	60.5
L3	59
L4	58
L5	60

UNLESS OTHERWISE NOTED.
RESISTANCE VALUES IN OHMS
CAPACITANCE VALUES IN UUF
INDUCTANCE VALUES IN UH

FIGURE 10. 60-MC POST AMPLIFIER, SCHEMATIC DIAGRAM

D. RECEIVER

An interconnection diagram, Figure 11 is provided to facilitate checking the wiring of the Receiver.

E. FACTORY REPAIR

If the equipment is to be returned to the manufacturer for repair, please return it in accordance with the following instructions.

1. Write to the AIL Sales Department, giving complete information concerning the failure and the manner in which the equipment was being used when failure occurred. Include the unit TYPE and SERIAL numbers.
2. Special shipping instructions will be supplied by AIL. When the shipping instructions are received, pack and ship the equipment as directed. Transportation charges should be prepaid and a failure report should be supplied with the equipment.

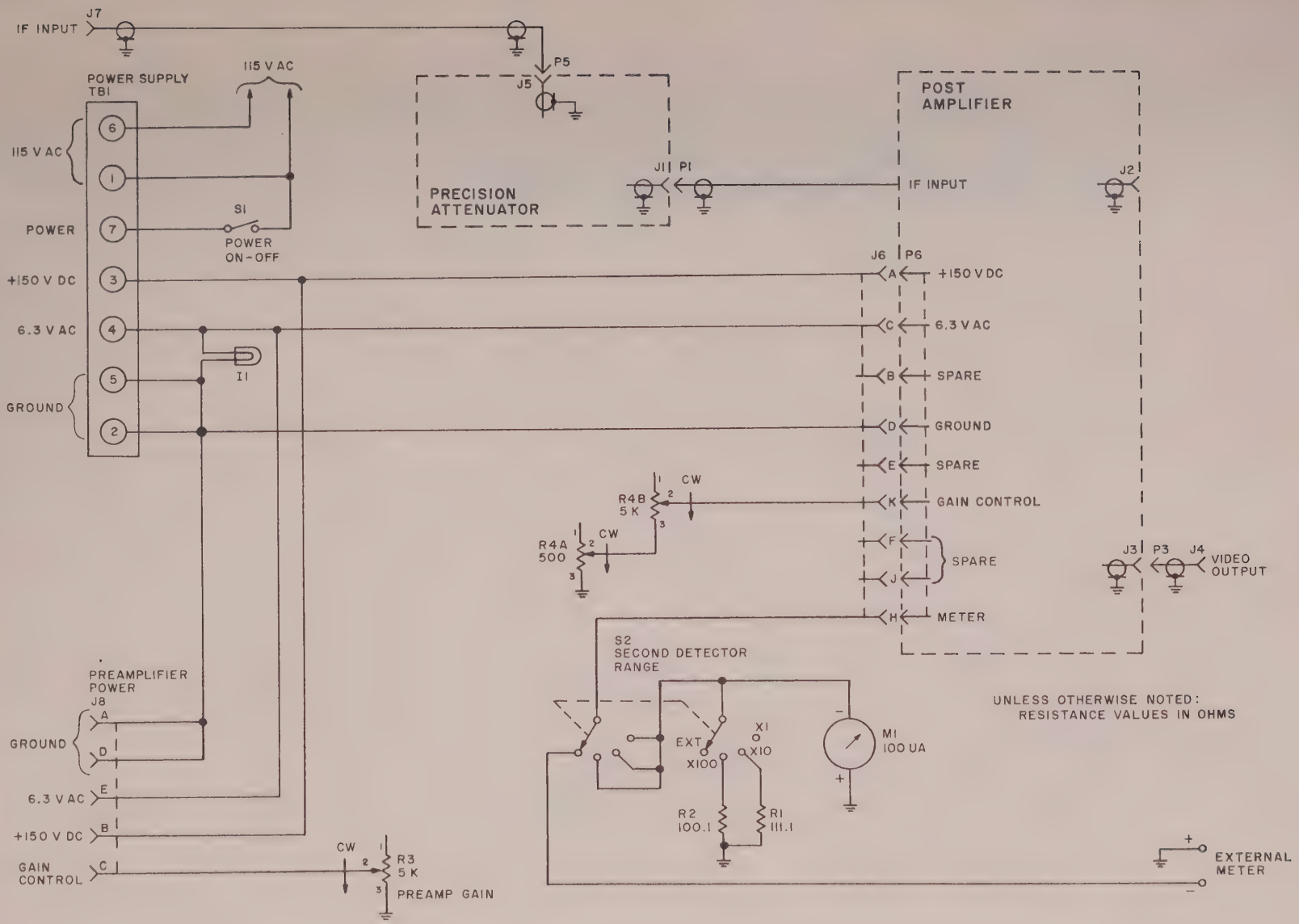
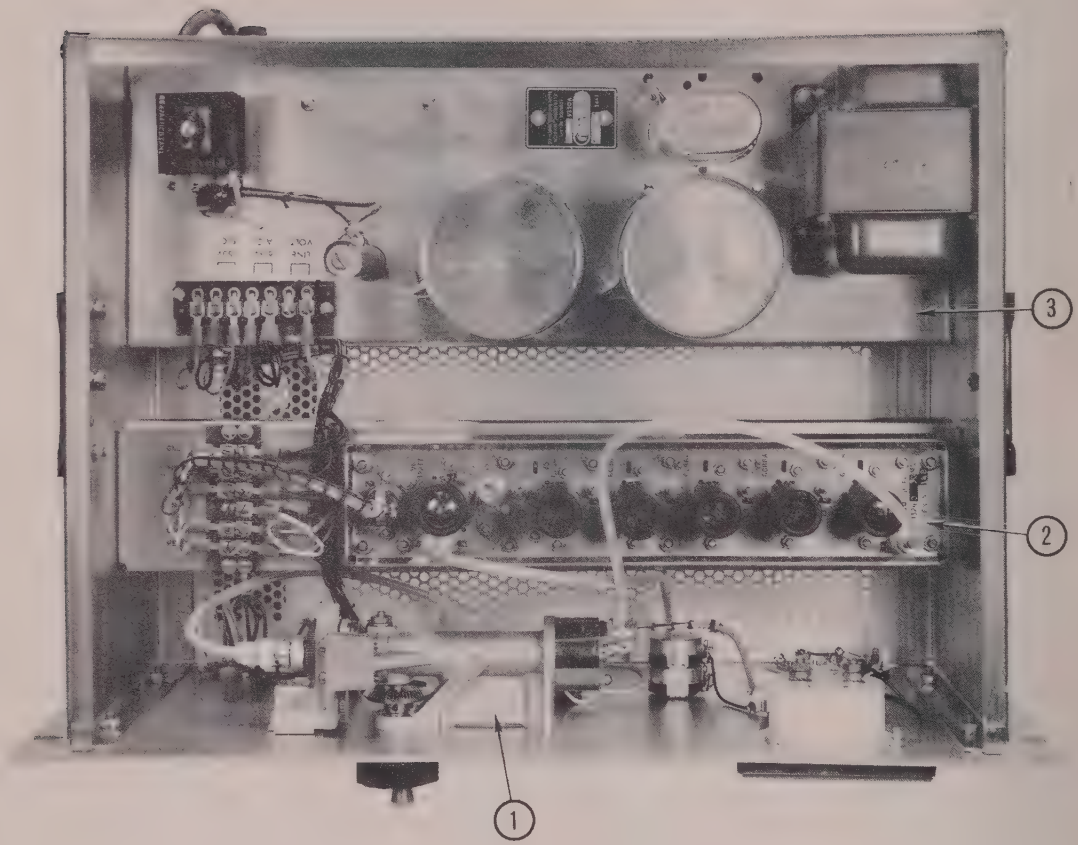


FIGURE 11. TYPE 132 PRECISION TEST RECEIVER, SCHEMATIC DIAGRAM



1. Attenuator
2. Post Amplifier (30 Mc or 60 Mc)
3. Power Supply

FIGURE 12. COMPONENT IDENTIFICATION

VII. REPLACEABLE PARTS LIST

TYPE 132 RECEIVER

Reference Symbol	Description	Manufacturer	Part No.
(Figure 12)			
1	Attenuator (30 Mc)	AIL	03030
	Attenuator (60 Mc)	AIL	03060
2	Post amplifier (30 Mc)	AIL	13240
2	Post amplifier (60 Mc)	AIL	13241
3	Power supply	AIL	114841
(Figure 11)			
I1	Pilot light	GE	47
J4, J7	Connector, BNC	IPC	2575
J8	Connector, power	Amphenol	165-136
M1	Meter, 0 to 100 μamp	AIL	118175-1
P3, P5	Connector, BNC	IPC	UG-88/U
R1	Resistor, fixed	AIL	118578-1
R2	Resistor, fixed	AIL	118578-2
R3	Resistor, variable, 5 k	Clarostat	CM 25969
R4	Resistor, variable, 5 k	AIL	118634-1
S1	Switch, rotary	AIL	118635-1
S2	Switch, rotary	AIL	118636
J6	Connector, power	Amphenol	126-222

Power Supply, Part No. 114841

(Figure 8)			
C1	Capacitor, .85 μf, 850 v AC	Sola	13144
C2, C3	Capacitor, 1500 μf, 200 v	Sola	9890-6
D1	Rectifier, bridge	GE	4JA411CB1AM1

Reference Symbol	Description	Manufacturer	Part No.
F1	Fuse, 2 amp	Bussmann	3 AG
L1	Choke	Sola	9-351
R1	Resistor, 2.2 k, 1/2 w	Allen-Bradley	RC20GF222J
R2	Resistor, 1500 Ω, 50 w	Ohmite	0406
T1	Transformer	Sola	9-1535
TD1	Time delay, 5 to 60 sec	Advance	DT/1A/115VA

30-Mc Post Amplifier, Part No. 13240

(Figure 9)

C1 thru C6	Capacitor, 715 pf	Erie	331-715
C7	Capacitor, .001 μf	C-D	59TM6D1
C8, C9	Capacitor, 4 μf, 150 v	Illinois Cond	SMT 4150
C10 thru C17	Capacitor, .001 μf	C-D	59TM6D1
C18	Capacitor, 20 pf	Erie	GP-20
C19	Capacitor, 20 μf, 25 v	C-D	NLW 20-25
C20 thru C41	Capacitor, .001 μf	C-D	59TM6D1
CR1	Diode	Raytheon	1N67
J2, J3	Connector, BNC	Amphenol	UG-625/U
L1	Coil, variable	AIL	114818
L2, L3	Coil, variable	AIL	114819
L4	Coil, variable	AIL	114820
L5	Coil, variable	AIL	114821
L6 thru L20	Choke, 14 μh	Speers	10102-1
L21 thru L26	Choke, .25 μh	Speers	10100-1
P1	Connector, BNC	Amphenol	UG-88/U
P6	Connector, power	Amphenol	126-219
R1	Resistor, fixed, 2.7 k		RC20GF272J
R2, R3	Resistor, fixed, 1.6 k		RC20GF162J
R4	Resistor, fixed, 2.7 k		RC20GF272J
R5	Resistor, fixed, 1.2 k		RC20GF122J
R6	Resistor, fixed, 100 k		RC20GF104J

Reference Symbol	Description	Manufacturer	Part No.
R7	Resistor, fixed, 12 k		RC20GF123J
R8	Resistor, fixed, 1 meg		RC20GF105J
R9, R10, R11	Resistor, fixed, 51 Ω		RC20GF510J
R12, R13, R14	Resistor, fixed, 180 Ω		RC20GF181J
R15	Resistor, fixed, 2.4 k		RC20GF242J
R16	Resistor, fixed, 1 meg		RC20GF105J
R17	Resistor, fixed, 820 Ω		RC20GF821J
R18	Resistor, fixed, 82Ω		RC20GF820J
V1 thru V5	Tube, electron		6CB6A
V6	Tube, electron		12AT7

60-Mc Post Amplifier, Part No. 13241

(Figure 10)

C1 thru C6	Capacitor, 715 pf	Erie	331-715
C7	Capacitor, .001 μf	C-D	59TM6D1
C8, C9	Capacitor, 4 μf, 150 v	Illinois Cond	SMT415D
C10 thru C17	Capacitor, .001 μf	C-D	59TM6D1
C18	Capacitor, 20 pf	Erie	GP-20
C19	Capacitor, 20 μf, 25 v	C-D	NLW 20-25
C20 thru C41	Capacitor, .001 μf	C-D	59TM6D1
J2, J3	Connector, BNC	Amphenol	UG-625/U
L1 thru L4	Coil, variable	AIL	112243
L5	Coil, variable	AIL	114822
L6 thru L20	Choke, 1.1 μh	Speers	10102-1
L21 thru L26	Choke, .25 μh	Speers	10100-1
P1	Connector, BNC	Amphenol	UG-88/U
P6	Connector, power	Amphenol	126-219
R1	Resistor, fixed, 5.6 k		RC32GF562J
R2, R3	Resistor, fixed, 2.7 k		RC20GF272J
R4	Resistor, fixed, 5.6 k		RC32GF562J
R5	Resistor, fixed, 2.2 k		RC20GF222J

Reference Symbol	Description	Manufacturer	Part No.
R6	Resistor, fixed, 100 k		RC20GF104J
R7	Resistor, fixed, 12 k		RC20GF123J
R8	Resistor, fixed, 1 meg		RC20GF105J
R9, R10, R11	Resistor, fixed, 51 Ω		RC20GF510J
R12, R13, R14	Resistor, fixed, 180 Ω		RC20GF181J
R15	Resistor, fixed, 2.4 k		RC20GF242J
R16	Resistor, fixed, 1 meg		RC20GF105J
R17	Resistor, fixed, 820 Ω		RC20GF821J
R18	Resistor, fixed, 82 Ω		RC20GF820J
V1 thru V5	Tube, electron		6CB6A
V6	Tube, electron		12AT7

APPENDIX

PREAMPLIFIERS

Several preamplifiers are available for use with the Type 132 Receiver. They are designed for remote location, away from the Receiver and convenient to the IF output of the device being tested.

The specifications for the preamplifiers are:

	30 Mc				60 Mc		
PART NUMBER	13230	13412	13131	13132	13231	13414	13161
INPUT CONFIGURATION	Single-ended	Single-ended	Double-ended unbalanced	Double-ended balanced	Single-ended	Single-ended	Double-ended unbalanced
BANDWIDTH 3 db (min)	2 Mc	8 Mc	2 Mc	1.6 Mc	2 Mc	8 Mc	2 Mc
TYPICAL SELECTIVITY							
(f center ±10 Mc)	−40 db	−40 db	−40 db	−40 db	−40 db	−40 db	−40 db
(f center ±20 Mc)	−60 db	−60 db	−60 db	−60 db	−60 db	−60 db	−60 db
BAND-PASS RIPPLE	Negligible	<1 db	Negligible	Negligible	Negligible	<1 db	Negligible
NOISE FIGURE AVERAGED OVER PASS BAND							
TYPICAL	1.6 db	1.6 db	1.6 db	2.5 db	2.6 db	2.8 db	2.6 db
MAXIMUM	2.0 db	2.2 db	2.0 db	2.9 db	3.0 db	3.4 db	3.0 db
SOURCE IMPEDANCE	400 ohms 40 pf	400 ohms 40 pf	150 ohms 15 pf	300 ohms 10 pf	400 ohms 40 pf	400 ohms 40 pf	200 ohms 10 pf
LOAD IMPEDANCE	50 ohms	50 ohms	50 ohms	50 ohms	50 ohms	50 ohms	50 ohms
VOLTAGE GAIN (min)	1000	500	300	200	1000	500	200
POWER GAIN (min)	75 db	69 db	57 db	57 db	75 db	69 db	55 db
GAIN CONTROL RANGE (min)	30 db	30 db	30 db	30 db	30 db	30 db	30 db
BANDWIDTH CHANGE WITH MAXIMUM GAIN CHANGE	<0.3 Mc	<1.0 Mc	<0.8 Mc	<0.3 Mc	<0.3 Mc	<1.0 Mc	<0.8 Mc
CENTER FREQUENCY SHIFT WITH MAXIMUM GAIN CHANGE (% of f center)	<1%	<1%	<3%	<3%	<1%	<1%	<3%
DYNAMIC RANGE LINEARITY FOR VOLTAGE MEASUREMENTS	+0.0, −1.0 db, from 20 to 60 db above minimum discernible signal						
	+0.0, −0.5 db, from 30 to 50 db above minimum discernible signal						
FOR NOISE POWER MEASUREMENTS	+0.0, −0.5 db, from 0.0 to 50 db above minimum discernible signal						
	+0.0, −1.0 db, from 0.0 to 60 db above minimum discernible signal						
OVERALL SIZE (inches)	Length: 13; Width: 2½; Height: 3¾. (Height: 5¾ for 13131, 13132, 13161)						

PREAMPLIFIER OPERATION NOTES

1. When the device to be measured is not connected to the precision attenuator, either directly or through linear passive elements, the linearity of the interposed unit (such as a mixer or preamplifier) will affect the accuracy of the measurement.
2. Saturation in the output stage of the preamplifier causes nonlinear response at the higher input levels.
3. The inability of the Receiver output detector to distinguish between the desired signal and the background noise causes an additional error that appears to be due to nonlinear response at low signal levels.

The following precautions should be observed to minimize these errors.

1. The input circuits, including the mixer, should have as low a noise figure as practical to minimize the background noise level.
2. The local oscillator input power should be at least 10 db more than the highest signal level to be used to avoid nonlinear response in the mixer. This is ordinarily not a problem since crystal mixers require approximately 1 mw of local oscillator power for optimum noise figure and this level is at least 30 db above the highest signal level that can be applied to the preamplifier input.
3. The gain control of the preamplifier should be set approximately 30 db below its maximum position. Further reductions in gain do not increase the linear dynamic range significantly because a reduction in the output capability of the preamplifier occurs that nullifies the advantage of the lower gain.

Under the above conditions, input signal levels may be used in the range from 20 to 60 db above the background noise level (assuming an input noise figure of 10 db) without incurring an error of more than 1 db at either end of this range.